Methods for determining depreciation

Depreciation costs can be determined by different methods

(1) Straight-Line Method

In this method it is assumed that the value of the property decreases linearly with time. Equal amounts are charged for depreciation each year throughout the entire service life of the property (or asset)

If
- V = original cost of the asset
- V_s = salvage value at the end of the service life
- n = service life (in years)
- d = annual depreciation

Depreciable capital = $V - V_s$

Annual depreciation = $$\boxed{d = \frac{V - V_s}{n}}$$

Book value of the asset after 'x' years can be determined as, $V_x = V - xd$

This is the simplest method for estimating depreciation costs and is hence, very popular

- When an asset is first used it is impossible to exactly determine the service life and salvage value. Therefore, it might be necessary to determine these factors from time to time, during the life period of the property. If this is done, straight line depreciation can be assumed during each of these periods and the overall method is known as "***multiple straight line depreciation***"

(2) Declining balance (or Fixed Percentage) Method

When the declining-balance method is used, the annual depreciation cost is a fixed percentage of the property value (book value) at the beginning of the year

The fixed percentage (or declining balance) factor remains constant throughout the entire service life of the property, while the annual cost for depreciation is different each year

Declining balance (or Fixed Percentage) Method (…contd)

If f is the fixed percentage factor and V the original cost of the asset,

Depreciation cost for the 1st year of the asset's life = Vf

[f is the fraction by which an asset is depreciated every year]

Therefore, book value at the end of 1st year (or beginning of 2nd year) = $V - Vf$ = $V(1-f)$

Depreciation cost for the 2nd year = $V(1-f)f$

Book value at the end of the 2nd year (or beginning of 3rd year) = $V(1-f) - V(1-f)f$

= $V(1-f)(1-f)$

= $V(1-f)^2$

Therefore, Book value at the end of the nth year = $V(1-f)^n$ [n = service life]

This is the same as salvage value, $V(1-f)^n = V_s$

Therefore, $$\boxed{f = 1 - \left(\frac{V_s}{V}\right)^{1/n}}$$ This is called the Matheson formula

A comparison of the change in the asset value for the straight line and the declining balance method shows that the declining balance method permits the investment to be paid off more rapidly during the early years of the life

The above equation, however, cannot be used if the salvage value is zero. An arbitrary value of f is chosen.

Also, in most cases, govt puts a restriction that f calculated by this method cannot be more than double the f calculated by straight line method

(3) Double Declining Balance Method

In this method, the factor f used for estimating depreciation is twice the value obtained from the straight line method (see Ex. 1 in Chapter 9, Pg 282)

(4) Sum-of-the –Year-Digits Method

The sum-of-the-year-digits method uses a fraction to estimate the depreciation per year similar to the declining-balance method.

Larger costs of depreciation are allotted to the early-life years than during the later years. This method allows the asset value to decrease to zero or a given savage value at the end of service life

The fraction or yearly depreciation factor is the number of useful years remaining divided by the sum of the total number of years.

This factor times the total depreciable value at the start of the service life gives the annual depreciation cost.

Sum-of-the –Year-Digits Method (…contd)

Depreciable fixed capital = $V - V_s$

Length of service life = n

Depreciation for 1st year = $d_1 = (V - V_s) \times \frac{n}{\sum_1^n n}$

Depreciation for 2nd year = $d_2 = (V - V_s) \times \frac{(n-1)}{\sum_1^n n}$

Depreciation for 3rd year = $d_3 = (V - V_s) \times \frac{(n-2)}{\sum_1^n n}$

Depreciation for nth year = $d_n = (V - V_s) \times \frac{1}{\sum_1^n n}$

Total depreciation = D = d_1+ d_2 + d_3 +…….+ d_n = $(V - V_s)$

$$(V - V_s) = (V - V_s) \times \frac{1}{\sum_1^n n} + (V - V_s) \times \frac{2}{\sum_1^n n} + \ldots\ldots\ldots + (V - V_s) \times \frac{(n-1)}{\sum_1^n n} + (V - V_s) \times \frac{n}{\sum_1^n n}$$

$$= (V - V_s)\left[\frac{1+2+3+\cdots\ldots+(n-1)+n}{\sum_1^n n}\right] = (V - V_s)\left[\frac{\sum_1^n n}{\sum_1^n n}\right]$$

$$= (V - V_s)$$

Sum-of-the –Year-Digits Method (…contd)

The invested capital investment is recovered during the service life by means of depreciation

General expression:

Depreciation for the mth year by sum-of-the-year-digits method is $= \frac{(n-m+1)}{\sum_1^n n}(V - V_s)$

$$d_m = \frac{(n-m+1)\times 2}{n(n+1)}(V - V_s)$$

(4) Sinking-Fund Method

This method assumes that the basic purpose of depreciation allowance is to accumulate sufficient fund to provide for the recovery of the original capital invested in the property.

An ordinary annuity plan is set up wherein a constant amount of money should theoretically be set aside each year

The use of compound interest is involved in this method

At the end of service life,

the sum of all the deposits + interest accumulated = total amount of depreciation

Sinking Fund Method (…contd)

Uniform annual payment made at the end of each year =annual depreciation cost = R

Interest rate = i

Depreciable capital = annuity sum at the end of service life of n years = $V - V_s$

We had seen earlier, $S = \frac{R[(1+i)^n - 1]}{i} = (V - V_s)$

Therefore, annuity = $$R = (V - V_s)\frac{i}{[(1+i)^n - 1]}$$

The amount accumulated in the fund after 'a' years of useful life = total amount of depreciation up to that time limit

= original value of property (V) – asset value (V_a) at the end of 'a' years

Total depreciation after 'a' years = $(V - V_a)$

Therefore, $$(V - V_a) = \frac{R[(1+i)^a - 1]}{i}$$

Putting the value of R from the above equation in this one gives, $(V - V_a) = (V - V_s)\frac{[(1+i)^a - 1]}{[(1+i)^n - 1]}$

Book value after 'a' years of useful life = V_a

$$V_a = V - (V - V_s)\frac{[(1+i)^a - 1]}{[(1+i)^n - 1]}$$

Comparison of depreciation calculation methods

- For Straight Line and Sinking Fund methods, annual depreciation costs are constant
- Both Declining Balance Method and Sum-of-the-year-digits Method give greater depreciation costs (annual) in the early years of the property than in the later years